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CELLULOSE DERIVATIVES IN THE SERVICE OF MAN.

Nitrocellulose Industry: a Compendium of the History, Chemistry, Manufacture, Commercial Application, and Analysis of Nitrates, Acetates, and Xanthates of Cellulose as Applied to the Peaceful Arts; with a Chapter on Gun-Cotton, Smokeless Powder, and Explosive Cellulose Nitrates. By Dr. Edward C. Worden. Vol i., pp. xxxiv+565. Vol. ii., pp. xxviii+567–1239. (London: Constable and Co., Ltd., 1911.) Price, two vols., 42*s.* net.

WHEN Schönbein first announced his discovery of gun-cotton little could he have foreseen that he was laying the foundation of so many important industries as those, sixty-five years later, associated with cellulose derivatives, for although the acetates and xanthates of this parent substance are daily growing in importance, their introduction has solely been due to the wide and successful application of the nitrocelluloses. One may safely say that the derivatives of no other single chemical substance (if cellulose in its varied forms may be so termed) have proved of such general use to mankind, assisting in the production at a cheap rate of numbers of articles hitherto made from expensive natural products, developing important branches of photography, rendering valuable service to the man of science and medical man, and finally furnishing the base of all the modern smokeless powders. The author has succeeded in these two comprehensive volumes in admirably treating of all the discoveries and applications of these highly important derivatives. The magnitude of such a work and the thoroughness with which it has been carried out may be realised from the fact that more than 8000 literature references and 5000 patent references have been verified.

The preparation of the nitrocelluloses and their stabilising is of the first importance, and is very clearly dealt with. An important point is the effect of prior treatment of the cotton, before nitration, on the character of the product and its stability. In general cotton treated with bleaching powder solutions or mercerised by alkali gives a lower nitrogen content, a greater ether-alcohol solubility, and renders subsequent stabilisation more difficult.

The successful application of nitrocelluloses in the arts is almost wholly dependent on the use of proper solvents and obtaining solutions of the desired viscosity. The important part which amyl alcohol (*iso*), introduced by Stevens in 1882, has played in the artificial leather, lacquer, and other industries is paralleled by the important property of camphor in forming solid or suitable plastic bodies for other branches of the industry. The author estimates that some 450,000 gallons of amyl acetate are annually employed in the United States, so that he rightly devotes considerable space to its preparation and the chemistry of camphor also receives very full treatment.

Space does not permit of more than a brief reference to the numerous applications of nitrocellulose or the other derivatives; it seems that in one way or another they must have some interest for everyone, but especially for those engaged in any branch of science. The preparation of museum specimens, and particularly of sections for the microscope; for preservation of important writings by saturation of the paper (where Indian ink has been employed, of which shellac is a constituent and soluble in the nitrocellulose solvent—the paper must first be immersed in a 2 per cent. solution of gelatin and allowed to dry); for the production of special tubes for deep-sea soundings, the tubes being coated inside with silver chromate, are amongst the minor but still important applications of nitrocellulose solutions.

In the large industries built up on cellulose derivatives during the last twenty years mention may be made of its application in the manufacture of incandescent mantles, both for coating the mantle to enable it to withstand the shocks of transport and handling, and the production of mantles themselves by the ejection of filaments containing the thoria and ceria, to be afterwards woven into mantles; the production of pyroxylin containing imitation leathers, of which a conservative estimate of the daily output of the United States is 45,000 yards, and for photographic purposes, where the applications of soluble nitrocelluloses are so numerous that considerable space is devoted to the subject. The production of continuous films has undoubtedly contributed more than any other discovery to the popularity of photography, and rendered the kinematograph a possibility. The extreme desirability of using non-inflammable films is emphasised from time to time by the ignition of ordinary films, so that the description of the preparation of cellulose acetate films will prove of value and a useful guide to future inventors.

The production of artificial silk is a triumph of the application of chemical substances to rival one of the most beautiful products of nature. Whilst in the early days it was thought to be a rival to the natural product, its lack of flexibility and strength have precluded this actually being the case; but the beauty of the filaments has given rise to so many new and decorative materials that, although not a rival, the demand for the artificial product was, for a period, so great that its price actually exceeded that of the natural silk. A brief reference can only be made to the early process of Chardonnet (1884), in which, as in most processes, an ether-alcohol solution of nitrocellulose is employed. The fluid was at first squirted through an orifice 0·5 mm. in diameter, the spinnarets falling into cold water which coagulated, their exterior forming a tube with a liquid interior, this coarse thread being then rapidly spun out into a thin filament. Later the orifice was reduced to 0·08 mm. Nitrocellulose silks are usually denitrated by means of an alkaline sulphide, so that finally they are essentially cellulose. It is of interest to compare the diameter of the artificial fibre with the natural. Chardonnet silk is given as 45 to 60 micromillimetres, while the natural silk is only 9 to 15, these figures being for the wet (swollen) fibres.

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The chapter on the military applications of cellulose derivatives is limited to eighty-five pages, but these contain a vast amount of information which, although familiar to those associated with this branch of the subject, is an excellent condensation of information.

So wide are the applications of cellulose derivatives and so admirably is the subject treated by the author that his two volumes should find a place in every technical and scientific chemist's library, and, further, will prove an invaluable reference book for the large number who are regularly employing many of these important bodies in their everyday work.

J. S. S. B.

EDUCATION FOR THE COUNTRY LIFE.

The Teaching of Agriculture in the High School. By Garland A. Bricker. Pp. xxv+202. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 4*s*. 6*d*. net.

STUDENTS of rural affairs have long realised that much dissatisfaction exists in country districts with our present system of education. In whatever way it is judged, according to its critics, it has failed; the children sent out from the country schools are not better fitted for work on the land than their fathers were; on the contrary, they are kept at desk work during the period when it is supposed that their receptive faculties are at the best, and when they would, on the land, most rapidly learn the ways of animals, of plants, and of soils. Even the friends of the system will concede that it has been evolved without any special regard for country requirements, and without taking account of the fundamental differences in habits of thought and in points of view between the dwellers in the town and those in the country.

More and more it is being realised that the future development of the rural district, or to put it still more widely, of the country civilisation, must run on different lines from that of the city, and experiments are therefore being made to evolve a system of education that shall train children to lead the life of the country. The experimental scale is largest in the States, as one might expect, and in the book before us Mr. Bricker has collected such of the material as is at present available, thus usefully filling a gap in our education literature. It is, of course, as yet too soon to speak about results, but during the experimental period it is useful for educationists to know what their American *confrères* are doing.

Of the elementary school but little is said. The nature-study idea is for the present the best we have, and has already a copious literature of its own. The work of the elementary schools, according to the author, should confine itself to an elementary study of the common things of the farm, field, and forest. Something of the relative importance of these things to man should be studied and fixed in the mind of the child before he leaves school. It is in the secondary school, or, as it is here called, the high school, that the scholars will take up agriculture as such, but there is no break in the sequence of studies because agriculture will be looked upon as nature-study *plus* utility. But the study of agriculture is to be an education and not simply a manual training.

> "If the essence of true culture is to see the fundamental and eternal shining out through the seemingly trivial and transitory, there is no subject better adapted to provide culture than the subject of agriculture."

To be treated in this broad way, agriculture requires a larger place in the school curriculum than the established secondary schools are able or willing to give it; hence the necessity for separate agricultural schools. Two possible dangers are indicated; specialised schools may emphasise class distinctions unworthy of a democratic country; education that makes a strong appeal to economic motives may be harmful if it places its powerful sanction on self-seeking ideals. The purely practical man, of course, will ask: Of what use are culture and adornment if the power to earn a livelihood is lacking? But this must not be the point of view of the agricultural teacher. He must rather insist on the other question: Of what use is the best capacity to make a living without a corresponding power to make life worth while? and make agriculture a cultural as well as a vocational subject. In short, the agricultural secondary school is to be the directive and constructive agent of the new rural civilisation that the best men in the States (and, for that matter, in this country also) are endeavouring to foster.

A chapter is devoted to the description of schools already established. They are, as one would expect, of several types, but in all of them boys and girls are educated together, entering at the age of thirteen or fourteen, and remaining for three or four years. Agriculture for the boys and household science for the girls form the respective centres of the courses, and the education is made as real as possible, *i.e.* the thing itself, whether a horse, a maize seed, or a growing crop, is before the class, and not simply a picture.

The author then proceeds to a discussion of methods. The logical arrangement of subjects followed in a college course is not the best for the boy with his limited experience and his incomplete and unorganised knowledge. It is necessary to adopt a psychological arrangement, *i.e.* a sequence of studies adapted to the changing and developing powers of the scholar. That the subject generally accords with the instincts and the impulses of the average boy is a tremendous help, and yet, unintelligently directed by the teacher, this help may prove a great danger. Into the psychological discussions we need not enter. The author's aim is to show that pedagogic principles can and should be applied to the teaching of agriculture, and that the subject can and should be made cultural as well as vocational.

The book affords a striking illustration of how much further the Americans have got than we ourselves. We are only commencing—if indeed we have seriously commenced—to apply the science of education in our agricultural teaching. Those who propose to essay the task will obtain useful help from this book.

E. J. R.

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